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warm hand as long as one has patience to hold them; they come up to the surface to breathe, and therefore do not consume much oxygen; they are perfectly hardy and easy to keep alive, eating small pieces of beef eagerly; they occasionally change their skins, bringing the old skin over their heads and then swallowing them just as toads do. Their odd motions in the water, often poising themselves on the end of the tail or on one toe, are very amusing. They lay their eggs in the early spring either on or between the leaves of water-plants. By the middle of August the young are nearly two inches long; they breathe at first with gills, but by September they come to the surface for air, as the older ones do. These tritons outlive all the other specimens in the tank, and they live so peaceably with their companions that they are invaluable as aquarial specimens.—*To be concluded.*

REVIEWS.

The Development of Insects.—Naturalists are now paying increased attention to the embryology of the articulates. After Rathke, Herold, and Kölliker had published their memorable works, there was an interval of twelve years between the publication, in 1842, of Kölliker's celebrated tract, entitled in Latin, "Observations on the first Genesis of Insects," and Zaddach's "Researches on the Development and Structure of Articulated Animals; Part I. The Development of Phryganidan Eggs," which appeared in 1854. Then followed Leuckart's "Propagation and Development of the Pupipara, from observations on Melophagus ovinus;" Huxley's article in the Linnæan Transactions, on the "Reproduction and Morphology of Aphis;" and Lubbock's essay on the "Ova and Pseudova of Insects," in the London Philosophical Transactions for 1859. Claparède, in 1862, published his splendid and beautifully illustrated prize essay on the "Evolution of Spiders," and a year after Weismann followed with a succession of brilliant works on the "Embryology and Anatomy of Diptera," which are in many respects the most important essays on the embryology of the hexapodous insects that have yet appeared, while the illustrations, very copious and detailed, are the most elaborate we have yet seen. Of great importance also is Mecznikow's "Researches on the

Embryology of the Hemiptera (Aphis, Aspidiotus, Corixa), and Simulium, and the viviparous Cecidomyian larva," which were printed in Siebold and Kölliker's Journal, in 1866.

At the meeting of the American Association, in August, 1867, the writer presented a paper on the Development of a Dragon-fly (Diplax), an illustrated abstract of which appeared in the NATURALIST, vol 1, p. 676. His studies did not embrace the earliest changes in the egg, but only those observed after the rudiments of the head and appendages appeared. In 1868 Dr. Alex. Brandt presented to the Imperial Academy of Sciences, of St. Petersburgh, a paper entitled "Contributions to the Developmental History of the Libellulidæ (Calopteryx and Agrion) and Hemiptera, with especial reference to the Embryonal integument" (blastoderm). With these two papers, the latter relating to the earliest changes in the eggs of Dragon-flies, and the former to the later stages in the life of the embryo, we have quite a complete account of the evolution of this remarkable family of insects. Dr. Brandt also gives the developmental history of certain Hemiptera (Corixa, Hydrometra, Lecanium and Aphis), and shows the remarkable identity in the embryology of these insects with the neuropterous insects mentioned above. A few other articles have appeared by Newport, Van Beneden, and others. We have already in the present volume of the NATURALIST, quoted from the abstract of Robins' paper on the "Development of Mites," quoted from the " Comptes Rendus" of the French Academy.

We would now notice the last work on the embryology of insects, that of Claparède, entitled "Studies on the Acarina," and published in Siebold and Kölliker's Journal of Scientific Zoölogy, during the present year. Claparède has observed in Atax Bonzi, which is a parasite on the gills of fresh-water mussels, that out of the originally laid egg (Pl. 8, fig. 3, embryo of *Tyroglyphus siro*, which closely resembles the earliest stages of the embryo of Atax; *vt*, yolk; *md*, mandibles; *mx*, maxillæ; p'–p''', legs. Fig. 4, front view of the same; R, beak; *p*, maxillæ), not a larva, but an egg-shaped form hatches, which he calls a "deutovum." (Pl. 8, fig. 1, bursting of the egg-shell into two halves, *mo*, on the day the deutovum, *dm*, hatches out; *md*, mandibles; *mx*, maxillæ; p''', third pair of legs; *lh*, body cavity; *sp*, common beginning of the alimentary canal and nervous system; *amb*, hæmabœba, amœba-like bodies, which represent the blood corpuscles; there being no circulation of the blood, the movements of the hæmabœba constitute a vicarious circulation. Fig. 2, the deutovum free from the first egg-shell; lettering same as in Fig. 1; *oc*, rudiments of the simple eyes; R, beak, *hh'*, rudimentary stomach and liver). From this deutovum (which is not the "amnion" of insects), is developed a six-footed larva. This larva passes into an eight-footed form, the "second larva" (the "nymph" or pupa, of Dujardin and Robin) which transforms into the adult mite. The pupa differs from the adult in having longer feet, and four instead of ten genital clasping cups, the latter being the usual number in the adult.

The larvæ are elongated oval, with six long legs and four ocelli. They swarm over the gills of the mussel they are living on for a short time, and then bore into the substance of the gill to undergo their next transformation. Here the young mite increases in size, and becomes round. The tissues soften, those of the different organs not being so well marked as in the first larval stage. The limbs are short and much larger than before, the whole animal assuming an embryo-like appearance, and moving about like a rounded mass in its enclosure. Indeed is this process not (though Claparède does not say so) a histolysis of the former larval tissues, and the formation of a new body, as in the change of the six-footed insect beneath the larva skin where the pupa is formed? A new set of limbs grow out, this time there being four instead of three pairs of legs, while the old larval skin is still embraced within the membrane containing the second larval round mass. Soon the body is perfected, and the pupa, as we may properly call it, slips out of the larval membrane.

The "second larva" after some time undergoes another change; the limbs grow much shorter and are folded beneath the body, the animal being immovable, while the whole body assumes a broadly ovate form, and looks like an embryo just before hatching, but still lying within the egg. This may also be comparable with the formation of the adult fly within the puparium. (Compare Weismann's account of this process in Musca, in our "Guide to the Study of Insects," pp. 63, 64.) This period seems to be an exact repetition of the histolysis, and the formation of new tissues for the building up of a new body, which preceded the pupal stage, while the adult mite slips out of its pupal membrane, just as the pupal mite throws off its larval membrane, like an adult butterfly, or fly, emerging from its pupal membrane.

Thus the mites, at least several species, pass through a series of metamorphoses similar to those of such insects as have a complete metamorphosis (except that the Acarian pupa is active), while the absence of such metamorphosis in the spiders, is paralleled by the incomplete metamorphosis of the orthoptera and many neuroptera, which reach adult life by simple moultings of the skin.

In the genus Myobia there is not only a deutovum, besides the original egg, but also a *tritovum-stage*. The eggs of this mite are long, oval and conical at the posterior end. The embryo with the rudiments of limbs is represented by Fig. 5 of Plate 8. The little tubercles *md* and *mx*, represent the mandibles and maxillæ, while the three pairs of legs, $p'p''p'''$, bud out from the middle of the body: *lc* represents the head-plate. The maxillæ and mandibles finally unite to form a beak (K, Fig. 6) and the three pairs of feet ($p'p''p'''$) are folded along the median line of the body. The farther development of the embryo is now for a time arrested, and a peculiar tooth-like process (Fig. 7, *d.*) is developed. Claparède thinks that by means of this the anterior end of the egg-shell is cut off, and the embryo protrudes through, when (as in Fig. 7) it is seen to be surrounded by a new membrane, the deutovum (*dt*), equivalent to that of Atax. The front pair of legs (p') have grown larger and stand out in front and on each side of the beak (R). The growing embryo again forces off the anterior end of its deutovum, and the oval end of the egg protrudes through, and is surrounded by another membrane. This is the *tritovum.* The embryo is now surrounded by the membrane of the tritovum, and also by the deutovular membrane and the original egg-shell, the last two having lost a small portion of the anterior end. During the tritovum-stage the fore pair of feet become curved in like claws, and the beak sinks down into the body.

Now the six-footed larva (Fig. 8) breaks through the shell, and closely resembles the adult (Pl. 8, Fig. 9). The first pair of feet modified for grasping the hairs of the field mouse, on which it is a parasite, take the place of the maxillæ, which have been arrested in their development, and the mandibles (pr) assume a style-like form. After one or more moultings of the skin, a fourth pair of feet (p'''') are acquired, and the adult form results, which the author considers as the type of a new family of Acarina. Claparède also suggests the affinity of Myobia to the Tardigrades (Echiniscus and Lydella,) especially from the study of the structure of the style-like mandibles and their supports. We feel convinced, from the study of Claparède's figures and descriptions, that this comparison is very significant, and this has led us to consider the Tardigrades as a family of mites, related to Myobia and Demodex.

The developmental history of Tetranychus is fully given, and he shows that, in regard especially to the mouth-parts, it passes through an Ixodes-like stage, the beak of the young closely resembling that of the tick. Also, in less complete form, that of a species of Tyroglyphus, in which he shows that the genus Hypopus, which strongly resembles Gamasus, is the male state of several species of Tyroglyphus. Such species with Gamasus-like males he states should be separated from the true Tyroglyphi under the name of Hypopus. He also gives the developmental history of Hoplophora. Since many Oribatidæ pass through an Acarus-like stage, he, with Gervais, places them next to the Acaridæ. He likewise describes *Myocoptes musculinus* (Koch) a form allied to our *Dermaleichus pici-pubescentis* (see Pl. 6, Figs. 1, 2, 3.) The work is very fully illustrated with ten beautifully drawn folding plates.

The author concludes with a short chapter entitled "Für Darwin." He considers that many points in the organization of the mites, in relation to their modes of life, confirm the truth of Darwin's theory of the origin of species. He cites the structure of the clasping organs attached to the legs, by which they are enabled to grasp the hairs of their host, and instances the alternation in form and position of the first pair of legs in Myobia, and their wonderful adaptation for grasping the hairs of the mice on which they live. He also cites the case of a species of Hypopus, in which, as described by Dujardin, there is, on the hinder edge of the abdomen, two scoop-like lips by which they cling to the hairs of their host.

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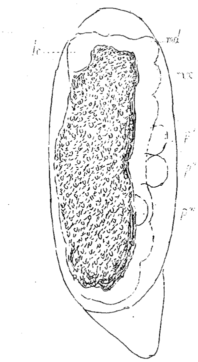

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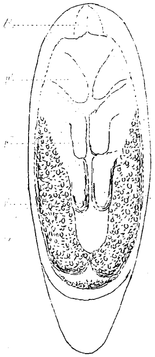

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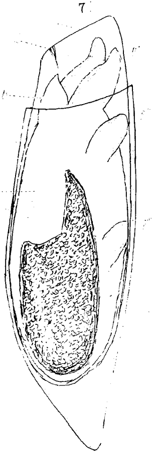

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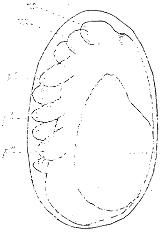

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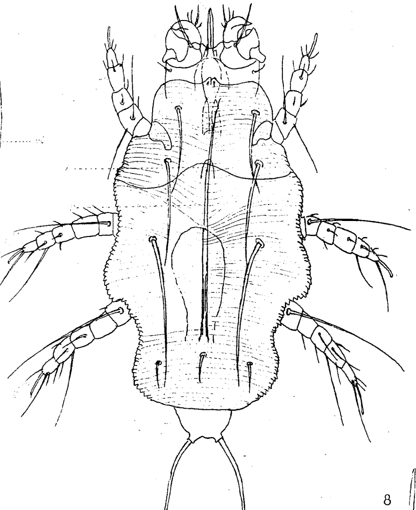

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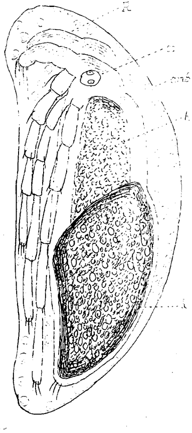

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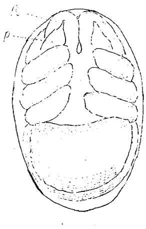

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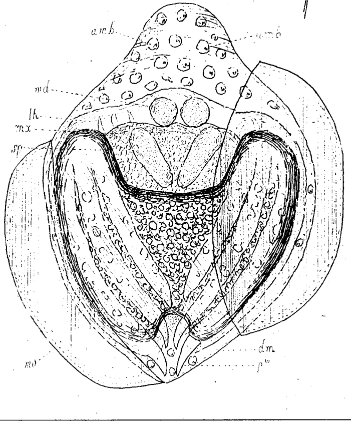

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